

# Arik Senderovich, PhD

---

## Employment

- 2019-** Assistant Professor, Faculty of Information, University of Toronto.  
Teaching: Data Modeling & Database Design, Machine Learning with Applications in Python.
- 2020-** Scientific Advisor, Product Strategy and Algorithms at mindzie (startup company).  
Job description: Algorithm development, product enhancement, data analytics.
- 2018-2019** Postdoctoral fellow, Faculty of Engineering and Applied Science, University of Toronto.  
Theme: *Data-Driven Modeling in AI: Learning congestion and Scheduling models from data.*  
Adviser: J. Christopher Beck.

## Education

- 2013-2016** PhD, Information Systems Engineering, Technion – Israel Institute of Technology.  
Theme: *Queue Mining: Service Perspectives in Process Mining.*  
Awards: **Best Dissertation Award in Business Process Management (BPM 2017).**  
Advisers: Avigdor Gal and Avishai Mandelbaum.
- 2007-2012** MSc, Statistics, Technion – Israel Institute of Technology.  
Theme: *Multi-Level Workforce Planning in Call Centers.*  
Adviser: Avishai Mandelbaum.
- 2002-2006** BSc, Industrial Engineering and Management, Technion – Israel Institute of Technology.  
Major: Information Systems Engineering.

## Awards

- Sep. 2017** Best dissertation award at BPM2017 (inaugural). Thesis title:  
*Queue Mining: Service Perspectives in Process Mining.*
- Sep. 2017** Best paper award at BPM2017. Paper title:  
*Temporal Network Representation of Event Logs for Improved Performance Modelling in Business Processes.*
- May 2017** The Lyon Sachs Postdoctoral Fellowship award (one recipient per year).
- Feb. 2016** Winner of the 1st Tech-Talks Competition. Talk title:  
*Mining Location Data for the Health Economy.*
- Dec. 2015** Industrial Engineering and Management Faculty Excellence Fellowship.
- Apr. 2015** Technion Excellence in Teaching.
- Oct. 2014** Industrial Engineering and Management Faculty Excellence Fellowship.

## Publications

### Journal Articles

*Exploiting Hardware and Software Advances for Quadratic Models of Wind Farm Layout Optimization*,  
Arik Senderovich, Eldan Cohen, Jason Zhang, J. Christopher Beck,  
Submitted to Renewable Energy, 2020.

*Interval-based Queries over Lossy IoT Event Streams*

Nimrod Busany, Han van der Aa, Arik Senderovich, Avigdor Gal, Matthias Weidlich,  
ACM/IMS Transactions on Data Science, Accepted for publication (Feb 2020).

*From Knowledge-Driven to Data-Driven Inter-Case Feature Encoding in Predictive Process Monitoring*

Arik Senderovich, Fabrizio Maria Maggi, Chiara Di Francescomarino,  
Information Systems, Volume 84, September 2019, Pages 255-264.

*Context-Aware Temporal Network Representation of Event Logs:*

*Model and Methods for Process Performance Analysis,*

Arik Senderovich, Matthias Weidlich, Avigdor Gal, Information Systems,  
Volume 84, September 2019, Pages 240-254

*Challenge Paper: Data Quality Issues in Queue Mining*

Avigdor Gal, Arik Senderovich, Matthias Weidlich,

J. Data and Information Quality, Volume 9(4), November 2018, Pages 18:1-18:5.

*REMI: A framework of reusable elements for mining heterogeneous data with missing information–  
A Tale of Congestion in Two Smart Cities*

Avigdor Gal, Dimitrios Gunopulos,

Nikolaos Panagiotou, Nicolo Rivetti, Arik Senderovich, Nikolas Zygouras,

J. Intell. Inf. Syst., Volume 51(2), 2018, Pages 367-388.

*To Aggregate or to Eliminate?*

*Optimal Model Simplification for Improved Process Performance Prediction*

Arik Senderovich, Matthias Weidlich,

Alexander Shleyfman, Avigdor Gal, and Avishai Mandelbaum,

Information Systems, Volume 78, 2018, Pages 96 - 111.

*Traveling Time Prediction in Scheduled Transportation with Journey Segments*

Avigdor Gal, Avishai Mandelbaum, Francois Schnitzler, Arik Senderovich and Matthias Weidlich,

Information Systems, Volume 64, June 2017, Pages 266-280.

*Conformance Checking and Performance Improvement in Scheduled Processes:*

*A Queueing-Network Perspective*

Arik Senderovich, Matthias Weidlich,

Liron Yedidsion, Avigdor Gal, Avishai Mandelbaum, Sarah Kadish, and Craig A. Bunnell,

Information Systems, Volume 62, December 2016, Pages 185–206.

*Queue Mining for Delay Prediction in Multi-Class Service Processes*

Arik Senderovich, Matthias Weidlich, Avigdor Gal, and Avishai Mandelbaum,

Information Systems, Volume 53, October–November 2015, Pages 278–295; Citations=55, Q=1, H-index = 72.

## **Refereed Conference Proceedings**

*Queueing Inference for Process Performance Analysis with Missing Life-Cycle Data*

Guy Berkenstadt, Arik Senderovich, Roei Shraga, Matthias Weidlich, Avigdor Gal,

Accepted to ICPM, 2020.

*Process Mining: Closing the Big Data Gap*

Avigdor Gal, Arik Senderovich,

BPM2020, (20% acceptance rate).

*Socially-Aware Business Process Redesign*

Arik Senderovich, Joop J. Schippers, Hajo A. Reijers,

BPM2020, (20% acceptance rate).

*An Ising Framework for Constrained Clustering on Special Purpose Hardware*

Eldan Cohen, Arik Senderovich, J. Christopher Beck,

International Conference on the Integration of CP, AI, and OR, CPAIOR2020.

*Inductive Context-aware Process Discovery*

Roe Shraga, Avigdor Gal, Dafna Schumacher, Arik Senderovich, Matthias Weidlich,  
International Conference on Process Mining, ICPM2019.

*Learning Scheduling Models from Event Data*

Arik Senderovich, Kyle E.C. Booth, J. Christopher Beck,  
International Conference on Automated Planning and Scheduling, ICAPS2019.

*Congestion Graphs for Automated Time Predictions*

Arik Senderovich, J. Christopher Beck, Avigdor Gal, Matthias Weidlich,  
AAAI Conference on Artificial Intelligence, AAAI2019 (16% acceptance rate).

*Fusion-Based Process Discovery*

Yossi Dahari, Arik Senderovich, Matthias Weidlich, Avigdor Gal,  
CAiSE2018, (21% acceptance rate).

*How Much Event Data Is Enough? A Statistical Framework for Process Model Discovery*

Martin Bauer, Arik Senderovich, Avigdor Gal, Lars Grunske, Matthias Weidlich,  
CAiSE2018, (21% acceptance rate).

*Temporal Network Representation of Event Logs for Improved Performance Modelling in Business Processes*

Arik Senderovich, Matthias Weidlich, Avigdor Gal,  
BPM2017, (13% acceptance rate; **best paper award**).

*Intra and Inter-case Features in Predictive Process Monitoring: A Tale of Two Dimensions*

Arik Senderovich, Chiara Di Francescomarino, Chiara Ghidini, Kerwin Jorbina, Fabrizio Maria Maggi,  
BPM2017, (13% acceptance rate).

*P3-Folder: Optimal Model Simplification for Improving Accuracy in Process Performance Prediction*

Arik Senderovich, Alexander Shleyfman, Matthias Weidlich, Avigdor Gal, Avishai Mandelbaum,  
BPM2016, (17% acceptance rate).

*In Log and Model we Trust?*

Andreas Rogge-Solti, Arik Senderovich, Matthias Weidlich, Jan Mendling, Avigdor Gal,  
BPM2016, (17% acceptance rate).

*The ROAD from Sensor Data to Process Instances via Interaction Mining*

Arik Senderovich, Andreas Rogge-Solti, Avigdor Gal, Jan Mendling, Avishai Mandelbaum,  
CAiSE2016, (17% acceptance rate).

*Data-Driven Performance Analysis of Scheduled Processes*

Arik Senderovich, Andreas Rogge-Solti, Avigdor Gal, Jan Mendling,  
Avishai Mandelbaum, Sarah Kadish and Craig A. Bunnell,  
BPM2015, (18% acceptance rate).

*Discovery and Validation of Queueing Networks in Scheduled Processes*

Arik Senderovich, Matthias Weidlich, Avigdor Gal,  
Avishai Mandelbaum, Sarah Kadish, and Craig A. Bunnell,  
CAiSE2015, (13% acceptance rate).

*Mining Resource-Scheduling Protocols*

Arik Senderovich, Matthias Weidlich, Avigdor Gal, and Avishai Mandelbaum,  
BPM2014, (17% acceptance rate).

*Queue Mining - Delay Prediction in Service Processes*

Arik Senderovich, Matthias Weidlich, Avigdor Gal, and Avishai Mandelbaum,  
CAiSE2014, (18% acceptance rate).

## Refereed Workshop Proceedings

*Predicting Traveling Times in Scheduled Transportation*,  
Avigdor Gal, Avishai Mandelbaum, Francois Schnitzler, Arik Senderovich and Matthias Weidlich,  
MUD Workshop@ICML, 2015.

*Discovering Queues from Event Logs with Varying Levels of Information*,  
Arik Senderovich, Sander J.J. Leemans, Avigdor Gal, Avishai Mandelbaum, and Wil M.P. van der Aalst,  
BPM Workshops, 2015.

*Service Analysis and Simulation in Process Mining*,  
Arik Senderovich, BPM Workshops, 2014

## Working Papers

*Learning Intervention-Driven Simulation Models from Event Data*,  
Arik Senderovich, Opher Baron,  
Working Paper, 2020.

*Capacity Planning and Scheduling in Cloud Services*,  
Arik Senderovich, Alexander Shleyfman, J. Christopher Beck,  
Working Paper, 2020.

*Waiting Time Prediction with Invisible Customers*,  
Ricky Roet-Green, Arik Senderovich, Yaron Shaposhnik,  
Working Paper, 2020.

*Modeling Provider Learning Curves using Real-Time Locating System Data*,  
Arik Senderovich, Petar Momcilovic, Nikolaos Trichakis,  
Working Paper, 2020.

*Process-Driven Partitioning of Long-Running Cases in Customer Journey Logs*,  
Gael Bernard, Arik Senderovich, Periklis Andritsos,  
Working Paper, 2020.

## Research Grants

- 2019-2020** Research grant: “Workload Prediction and Optimal Resource Management for Cloud Services”,  
300K CAD, co-PI, jointly with J. Christopher Beck. Industrial Partner: Huawei Technologies (Canada).
- 2020-2021** Travel grant: “Privacy-Preserving Publishing of Process Data”,  
15K EURO, jointly with J. Christopher Beck and Matthias Weidlich.
- 2020-** Research grant: “Business Automation On-the-Go”,  
90K CAD, jointly with Eric Yu. Industrial Partner: IBM Canada, IBM Center for Advanced Studies.

## Teaching Experience

- 2019-2020** Business Process Management and Mining.  
Grad course; Faculty of Information, University of Toronto.
- 2020** Machine Learning with Applications in Python.  
Grad course; Faculty of Information, University of Toronto.
- 2019-2020** Data Modeling and Database Design.  
Grad course; Faculty of Information, University of Toronto.

- 2019** System Analysis and Process Innovation.  
Grad course; Faculty of Information, University of Toronto.
- 2018-2019** Business Process Management and Mining.  
Grad course; Department of Mechanical and Industrial Engineering, University of Toronto.
- 2018** Integrated Systems Design.  
Undergrad course; Department of Mechanical and Industrial Engineering, University of Toronto.
- 2017** Summer School: Decisions, Laws, and the Big Data Revolution.  
Technion–Israel Institute of Technology.
- 2015-2017** Business Process Management and Mining.  
Grad/undergrad course; Technion–Israel Institute of Technology.
- 2015-2016** Data Mining with Applications in R.  
Grad course; Technion–Israel Institute of Technology.

## Graduate Students and Postdocs

### Alex Shleyfman (Postdoctoral Fellow)

*Title:* "Capacity Planning and Scheduling in Cloud Services".

Project start: October 2019. Co-supervised with J. Christopher Beck.

### Gael Bernard (Postdoctoral Fellow)

*Title:* "Cutting Customer Journeys for Process Mining".

Project start: October 2020. Co-supervised with Periklis Andritsos.

### Rohith Sothilingam (MI Thesis)

*Title:* On "Towards Higher Maturity for Machine Learning: A Conceptual Modelling Approach".

Completion date: TBD. Second reader.

### Luke Cui (MAsc Thesis)

*Title:* "Modeling and Learning Workload Models in Cloud Applications".

Completion date: August 2020. Co-supervised with J. Christopher Beck.

### Kunlong Li (MEng Thesis)

*Title:* "Solving Petri net Reachability Problems with Heuristic Search".

Projected completion: December 2018. Co-supervised with J. Christopher Beck.

### Yossi Dahari (MSc Thesis)

*Title:* "Fusion-Based Process Discovery".

Completion date: August 2018. Co-supervised with Avigdor Gal.

## Professional Activities

- 2020-** Member of the Program Committee of IPA,  
The AAAI Workshop on Intelligent Process Automation.
- 2019-** Member of the Program Committee of ATAED,  
The Algorithms & Theories for the Analysis of Event Data 2020 Workshop.
- 2019-** Member of the Program Committee of AAAI,  
The Thirty-Fourth AAAI Conference on Artificial Intelligence.
- 2017-** Member of the Program Committee of BPM,  
The International Conference on Business Process Management.
- 2017-** Member of the Organizing Committee of AI4BPM (co-Founder),  
The Artificial Intelligence for Business Process Management Workshop.

## Invited Talks

- Nov. 2020**    INFORMS annual meeting (Virtual).  
Title: Automated Mining Of Simulation Models Using Event Data.
- Oct. 2019**    INFORMS annual meeting (Seattle, WA).  
Title: Learning Scheduling Models from Event Data.
- Jul. 2019**    INFORMS in Healthcare Conference (Boston, MA).  
Title: From Low-level Events to Activities via Interaction Mining.
- Dec. 2018**    Industrial Engineering Dept. at Tel Aviv University.  
Title: Queue Mining: Predictive Analysis of Congested Systems.
- Oct. 2018**    Simon School of Business at Rochester University.  
Title: Queue Mining: Predictive Analysis of Congested Systems.
- Jun. 2018**    UTOrg Seminar.  
Title: On the Symbiosis between Process Mining and Operations Research.
- Nov. 2017**    Information Technologies Department at Haifa University.  
Title: Queue Mining: Predictive Monitoring in Resource-Driven Processes.
- Aug. 2017**    The Dana-Farber Cancer Institute.  
Title: Queue Mining using Real-Time Location Data.
- Aug. 2017**    The TIDEL seminar at University of Toronto.  
Title: Queue mining: service perspectives in process mining.
- Jun. 2017**    Production and Operations Management Society annual Conference (POMS2017).  
Title: Feature Learning for Accurate Time Prediction in Congested Health Systems.
- May 2017**    Statistics Department at Haifa University.  
Title: Queue mining: Service perspectives in process mining.
- May 2017**    The annual Israeli Statistics Association Conference.  
Title: Feature Mining for Accurate Time Prediction in Congested Health Systems.
- Nov. 2016**    The AIS group seminar at Eindhoven University of Technology (TU/e).  
Title: Queue mining: service perspectives in process mining.
- Nov. 2016**    The 10th Young European Queueing Theorists (YEQT) Workshop (Eindhoven, Netherlands).  
Title: Optimal model simplification to improve performance prediction in service processes.
- Sep. 2016**    The HKUST-Technion 2nd Workshop at Hong-Kong, China.  
Title: Optimal model simplification to improve performance prediction in service processes.
- May 2014**    The HKUST-Technion 1st Workshop at Haifa, Israel.  
Title: Queue mining: Service perspectives in process mining.

## Industrial Research Projects

- 2020-**        Business Process Automation on the Go.  
Partner: IBM Canada.  
Core idea: Automating flexible business processes.
- 2019-**        Resource Optimization in Cloud Services.  
Partner: Huawei Canada.  
Core idea: Time series prediction of workload, capacity planning and resource scheduling in cloud services.

- 2012-** Improving prediction and patient scheduling in a large hospital.  
Partner: Dana-Farber Cancer Institute (USA).  
Core idea: Mining Real-Time Location System data to predict delays and improve patient flow.
- 2019** Combinatorial Optimization with Quantum Computing.  
Partner: Fujitsu Canada.  
Core idea: Solving hard optimization problems using the Digital Annealer technology.
- 2018-2019** Process Mining in Ethereum Blockchain.  
Partner: ConsenSys.  
Core idea: Knowledge discovery from the Ethereum Blockchain using process mining.
- 2012-2017** 'Churn prediction and workforce planning'.  
Partner: Mizrahi-Tefahot Bank (Israel).  
Core idea: Using data mining methods to analyze customer churn and resource capacity.
- 2016-2017** 'InfoMedia' project: Predicting the Impact of External Events on Customer Value.  
Partner: The Office of the Chief Scientist of the Ministry of Industry and Trade, Israel.  
Core idea: Applying advanced Machine Learning methods to predict customer value.
- 2016-2017** 'Variety, Veracity, VaLue: Handling the Multiplicity of Urban Sensors' (VaVeL).  
European Union Project on Mining Heterogeneous Urban Data in Multi-Modal Environment.  
Core idea: Applying data mining methods in a smart cities project.
- 2013-2016** 'Intelligent synthesis and real-time response using massive streaming of heterogeneous data' (INSIGHT).  
European Union Project on Mining Heterogeneous Urban Data.  
Core idea: Applying data mining in Smart Cities.

## Additional Information

- **Legal Status.**  
Canadian Permanent Resident.
- **Programming Languages**  
Python, R , MATLAB.
- **Packages, Data Structures and Databases**  
MySQL, Microsoft Azure, PySpark, Sklearn, PyTorch, OR-Tools, CPLEX, Gurobi, TMLE: Causal Inference in R.
- **Languages**  
Hebrew, Russian, English.